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EFFECTS OF STORAGE ON STARCH AND SUGARS CONTENTS OF MAINE POTATOES

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Large surpluses of potatoes in 1943 and 1946 have spurred efforts to expand non-food outlets, such as starch manufacture. In the manufacture of potato starch and in other potato processing, it is necessary to store potatoes for several months in order to extend the operating season. Although many investigations have been carried out on potato storage, most of this work has dealt with the determination of proper storage conditions for table stock and seed potatoes. There is a real need for information on the storage of potatoes to be used in industrial processes. Operators of starch factories, for example, have noted that potatoes yield less starch in late winter and spring after storage at a relatively low temperature. Although no supporting data are available, they believe that starch produced late in the operating season is of lower quality than

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that obtained from freshly dug potatoes. Published reports show that storage at low temperatures decreases the percentage of starch and increases the percentage of sugars in potatoes, but it was considered desirable to obtain similar data on the types of potatoes commonly used in starch manufacture and to compare the quality of commercial starch produced from potatoes early in the season with that of starch from stored potatoes.

The two most popular varieties of potato grown in Maine—the Katahdin and the Green Mountain—were selected for the storage experiments, since most of the potatoes processed into starch in Maine are of these varieties. The potatoes were stored at temperatures ranging from 34° to 60° F. According to Stuart *et al.* (11), the temperature of a potato storage house in Aroostook County, Maine, ranges from 34° to 45° F. during the winter. Heat is supplied during extremely cold weather to prevent freezing, and increased ventilation with outside air is employed during mild weather to offset heat of respiration.

Review of the Literature

The most important chemical changes occurring during the storage of potatoes are in the starch and sugars. Müller-Thurgau (7) reported in 1882 that the sugar content of potatoes increased during cold storage or on slow freezing. This investigator also observed that when potatoes were taken from cold storage and exposed to a higher temperature (68° F.) the sugar content decreased. According to Appleman (1), three processes occur in a potato: (a) respiration, which consumes sugar by converting it into carbon dioxide and water; (b) conversion of starch to sugar by amylolytic enzymes; and (c) conversion of sugar to starch (presumably by starch-synthesizing enzymes). At low temperatures sugars increase and starch decreases; at higher temperatures, sugars decrease as a result of respiration and starch synthesis. Potatoes lose weight in storage, owing partly to evaporation of water and partly to respiration. Many investigators, including Hopkins (5), Barker (3), Kimbrough (6), and Smith (9), have studied the factors influencing rate of respiration.

Research workers in the Bureau of Plant Industry, Soils, and Agricultural Engineering have contributed to the potato-storage literature during the past 15 years. In a study on the influence of storage conditions on respiratory and other physiological changes, carbohydrate composition, and culinary quality of potatoes, Wright, Peacock, Whiteman and Whiteman (13) found that the percentage of starch decreased with decrease in storage temperature and that the sugar content increased in a commensurate amount. Wright (14) measured the decrease in content

of sugars accumulated during 5 months' storage at 32° F., after transferral of the potatoes to 60° storage. Wright, Caldwell, Whiteman and Culpepper (12), who recently investigated the effect of storage conditions on the quality of dehydrated potatoes, concluded that accumulation of sugars during low-temperature storage results in a sweet, soggy and badly discolored potato.

Denny and Thornton (4) have pointed out that the amount of sugars formed during cold storage of potatoes depends on variety as well as temperature. They likewise found that the extent of de-sugaring which occurs on exposure to higher temperatures is different in different varieties.

Barham, Kramer, and Reed (2) studied the changes in weight and in starch content of potatoes during 6 months (July to January) of cold and shed storage in Kansas. In this period the starch content fell from 14.7 to 9.6 per cent in cold storage and to 10.3 per cent in shed storage.

Materials and Methods

U. S. No. 1 Katahdin and Green Mountain potatoes of the 1945 crop were used in this study. The potatoes were grown at the Aroostook Farm of the Maine Agricultural Experiment Station, Presque Isle, on Caribou loam, fertilized with one-half ton per acre of fertilizer ($2N—4P_2O_5—5K_2O$) containing 1 per cent magnesium. The vines were sprayed with Bordeaux mixture (5 Ca $(OH)_2$-5 Cu $(SO_4)_2$-50 water) six times during the season. The vines were also sprayed with calcium arsenate solution, 2 pounds per 100 gallons of water. Except for a slight amount of leaf roll, disease in the potatoes was non-existent. Temperature and moisture were normal up to the 1st of August at Aroostook Farm, but a dry August produced smaller potatoes than usual. The potatoes were harvested on the 27th of September and held for 5 days at 50° to 60° F. after harvesting.

The storage boxes held 55-60 pounds of potatoes and were ventilated through slots about ¾ inch wide, placed at the bottom of one side and top of the opposite side. Care was taken in mixing and in distributing the potatoes in order to obtain uniform samples.

On the 2nd of October the potatoes were weighed, sampled, and then placed in storage bins at Aroostook Farm at the following temperatures and relative humidities: 34° F. and 81 per cent R. H.; 36° F. and 83 per cent R. H.; 38° F. and 82 per cent R. H.; 42° F. and 82 per cent R. H.; 50° F. and 87 per cent R. H.; 60° F. and 68 per cent R. H. Duplicate boxes of each variety were placed in each storage bin, one to serve as a source of samples and the other as a weight control. After 7,

13, 22, 29 and 37 weeks the potatoes were examined, weighed, and sampled. Each time duplicate three-pound samples (about 10 potatoes) were removed from each box for analytical determinations. One sample was finely ground (with a high-speed rasp or hammer mill), moisture was determined, and a portion was immediately preserved in alcohol for later analysis at the Eastern Regional Research Laboratory, where all other determinations were made. Sufficient absolute alcohol was used to give a final concentration of approximately 80 per cent alcohol after dilution with the potato juice. The alcohol-insoluble solids were used for the starch determination. It was necessary to determine sugars only in the alcoholic extract. When approximately 90 grams of finely ground potato were allowed to stand in 360 cubic centimeters of absolute alcohol for 1 week or longer at room temperature before analysis, practically all the sugars leached out into the 80 per cent alcohol. The duplicate set of samples was kept for about 2 weeks at ordinary temperatures (60°—70° F.), then ground and immediately analyzed.

Moisture was determined by drying a 15 to 20-gram sample of ground potato, spread thinly over the bottom of a shallow dish, in an oven at 120-°-135° F. for 4 to 6 hours and then at 275° F. for 2 hours. Starch was determined polarimetrically by the Steiner and Guthrie method (10). Sugars were determined by the official gravinometric methods (8) of the Association of Official Agricultural Chemists.

DATA AND RESULTS

Table 1 shows the changes in starch content during storage at the various temperatures and after 2 weeks at room temperature following removal from cold storage. The loss of starch was considerable at the lower temperatures 34°, 36°, and 38° F. At higher temperatures the change was less. The Katahdin potatoes changed little in starch content after 7 weeks' storage. The Green Mountains, however, continued to lose starch up to the thirteenth week of storage. After the potatoes were withdrawn from cold storage and kept at room temperature for 2 weeks or longer, the values for starch increased, approaching, on a percentage basis, the original value. The Green Mountain variety showed this tendency more definitely than the Katahdin variety.

It will be noted that some of the starch values for the Green Mountains, on the wet basis, are higher than the original starch content, undoubtedly owing to unusual loss of moisture. On the dry basis, however, no values exceed the original beyond the expected experimental error.

The changes in sugar content are given in table 2. A large increase in total sugars (primarily in reducing sugar) was found in potatoes stored at 34° and 36° F. The greatest change took place during the first 13 weeks

TABLE 1.—*Changes in starch content of potatoes during storage at various temperatures*[a]

TABLE 1.—*Changes in starch content of potatoes during storage at various temperatures*[a]

Storage Temperature, °F.	Starch Content after Storage of (Weeks)—					Starch Content after 2 Weeks at Room Temperature Following Withdrawal from Storage of (Weeks)—				
	7	13	22	29	37	7	13	22	29	37
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
	Katahdin (Original Starch Content 13.5 per cent (72.3).)									
34	9.7	10.3	9.6	9.8	9.9	12.1	12.4	13.1	10.4	10.8
	(56.1)	(54.5)	(55.9)	(55.2)	(56.2)	(64.2)	(63.2)	(66.5)	(57.9)	(60.3)
36	10.9	9.6	10.2	10.1	9.7	12.7	12.8	12.5	10.6	12.2
	(60.9)	(56.9)	(59.6)	(58.2)	(56.9)	(65.8)	(64.2)	(65.3)	(56.1)	(64.3)
38	11.5	11.3	11.1	—	11.2	12.9	13.4	13.0	12.0	11.4
	(62.8)	(63.6)	(64.4)		(61.1)	(68.9)	(66.0)	(66.4)	(62.9)	(63.3)
42	11.9	12.1	11.5	—	12.0	13.6	13.1	12.6	12.5	13.6
	(65.7)	(67.3)	(67.5)		(66.1)	(71.5)	(67.7)	(66.2)	(61.4)	(66.5)
50	11.9	12.6	12.1	12.1	--b/	13.0	13.4	13.4	11.4	--b/
	(66.1)	(68.9)	(68.9)	(71.7)		(69.7)	(66.9)	(68.1)	(58.6)	
60	12.8	13.2	12.0	12.1	--b/	13.3	13.3	13.8	13.8	--b/
	(71.1)	(73.6)	(68.4)	(62.9)		(69.9)	(64.0)	(65.6)	(56.9)	
	Green Mountain (Original Starch Content: 15.6 per cent (73.3).)									
34	13.0	11.4	12.5	11.8	12.1	15.2	15.1	14.9	14.6	15.6
	(69.0)	(58.8)	(62.7)	(60.0)	(61.5)	(71.3)	(71.7)	(70.1)	(70.1)	(71.1)
36	14.1	12.4	12.3	13.4	11.7	15.5	13.6	16.5	15.3	15.3
	(70.8)	(63.5)	(62.9)	(66.9)	(61.1)	(71.5)	(66.8)	(73.4)	(72.1)	(70.2)
38	15.0	13.9	13.1	13.6	13.8	15.9	15.7	16.2	14.6	16.8
	(73.9)	(69.3)	(67.0)	(70.2)	(67.1)	(74.1)	(72.7)	(72.3)	(68.1)	(71.1)
42	16.8	14.1	12.7	14.4	15.7	15.9	16.5	16.1	15.8	17.1
	(78.9)	(71.6)	(68.1)	(70.8)	(72.7)	(73.3)	16.2	(73.6)	(71.9)	(71.4)
50	16.6	14.6	15.2	14.7	--b/	15.7	(73.9)	16.4	17.6	--b/
	(81.8)	(72.1)	(70.8)	(73.1)		(73.5)	(73.8)	(73.4)	(74.0)	
60	16.6	15.4	14.8	14.7	--b/	16.0	16.2	17.5	17.1	--b/
	(80.2)	(73.4)	(70.5)	(66.0)		(73.4)	(73.5)	(73.4)	(60.0)	

a. Figures in parenthesis are on dry basis.
b. No determinations made. Sprouted too extensively to be utilized for any purpose.

TABLE 2.—*Changes in sugars Content of potatoes during storage at various temperatures*[a]

Storage Temperature, °F.	Total Sugars, Content after Storage for (Weeks)—					Reducing Sugars, Content after Storage for (Weeks)—				
	7 Per cent	13 Per cent	22 Per cent	29 Per cent	37 Per cent	7 Per cent	13 Per cent	22 Per cent	29 Per cent	37 Per cent
	Katahdins (Original Content: Total Sugars, 0.33 per cent (1.76); Reducing Sugars, 0.1 per cent (0.56).)									
34	1.8 (8.5)	3.2 (17.1)	2.5 (14.8)	2.4 (13.5)	3.1 (17.5)	1.4 (8.0)	1.9 (10.0)	1.8 (10.9)	1.5 (8.1)	1.9 (10.5)
36	1.2 (7.0)	2.6 (15.3)	2.6 (15.3)	2.1 (13.4)	2.1 (12.2)	1.4 (7.9)	1.8 (10.3)	1.9 (10.9)	1.6 (8.9)	1.5 (8.7)
38	0.8 (4.5)	1.5 (9.0)	1.2 (6.8)	—	1.0 (5.3)	0.8 (4.6)	1.1 (6.4)	0.9 (5.5)	—	0.8 (4.4)
42	0.4 (2.1)	0.5 (2.6)	0.6 (3.6)	—	0.3 (1.8)	0.3 (1.7)	0.1 (0.5)	0.3 (1.7)	—	0.3 (1.5)
50	0.2 (0.9)	0.25 (1.2)	0.3 (1.7)	0.3 (1.9)	—b/	0.1 (0.6)	— c/	0.1 (0.7)	0.2 (0.9)	— b/
60	0.2 (1.0)	0.2 (1.1)	0.3 (1.7)	0.6 (2.9)	—b/	0.1 (0.6)	— c/	0.1 (0.8)	0.4 (1.9)	— b/
	Green Mountain (Original Content: Total Sugars, 0.60 per cent (2.9); Reducing Sugars, 0.24 per cent (1.1).)									
34	2.9 (14.4)	3.3 (16.7)	2.6 (13.0)	2.5 (12.7)	2.3 (11.9)	1.7 (8.4)	2.1 (10.8)	1.6 (8.1)	1.8 (9.0)	1.8 (9.1)
36	2.1 (10.8)	2.7 (13.7)	2.0 (10.5)	1.8 (8.8)	2.3 (12.2)	1.5 (7.5)	1.9 (9.5)	1.5 (7.6)	1.3 (6.6)	2.0 (10.5)
38	1.6 (8.0)	1.8 (9.2)	1.0 (4.9)	1.2 (6.4)	1.3 (6.4)	1.1 (5.3)	1.3 (6.6)	1.2 (6.0)	1.0 (5.0)	1.1 (5.3)
42	0.6 (2.8)	0.9 (4.3)	0.7 (3.7)	0.7 (3.6)	0.6 (2.7)	0.4 (2.0)	0.4 (2.0)	0.6 (3.2)	0.5 (2.6)	0.5 (2.3)
50	0.6 (2.9)	0.7 (3.3)	0.4 (1.6)	0.6 (2.8)	— b/	0.35 (1.7)	0.2 (0.9)	0.3 (1.1)	0.6 (3.1)	— b/
60	0.4 (2.0)	0.5 (2.5)	0.4 (1.8)	1.3 (5.9)	— b/	0.3 (1.4)	0.1 (0.5)	0.3 (1.3)	0.7 (2.9)	— b/

a. Figures in parenthesis are on dry basis.
b. No determinations made. Sprouted too extensively to be utilized for any purpose.
c. Only trace present.

of storage. During the next 24 weeks the changes were less significant. At storage temperatures of 38° and 42° F., the increase in both total and reducing sugars was slight, and at 50° and 60° F. there was even a slight reduction in the amount of total sugars, particularly in the Kathadin variety.

As a general rule, the values for both reducing and total sugars of potatoes from cold storage decreased decidedly after 2 weeks' exposure to ordinary temperatures. Katahdins stored at 34° F. and sampled after 7, 13, and 22 weeks, for example, contained 8-½ to 17 per cent total sugars, as shown in table 2. (Data on the dry basis are discussed here to facili-

TABLE 3.—*Total sugars content of potatoes kept at room temperature for about 2 weeks after removal from cold storage*[a, b].

(*Same samples as in table 2*)

Storage Temperature, °F.	Katahdin			Green Mountain		
	Total Sugars Content after Storage for (Weeks)			Total Sugars Content after Storage for (Weeks)		
	7 Per cent	13 Per cent	22 Per cent	7 Per cent	13 Per cent	22 Per cent
34	1.1 (5.9)	1.0 (5.1)	1.0 (4.8)	0.6 (3.9)	0.8 (3.6)	0.7 (3.2)
36	0.9 (4.5)	0.8 (4.2)	0.8 (4.0)	0.5 (2.4)	0.7 (3.7)	0.7 (2.9)
38	0.6 (3.4)	0.7 (3.3)	0.7 (3.8)	0.5 (2.2)	0.6 (3.0)	0.7 (3.0)

a. Original sugar contents the same as in sugar table 2.
b. Figures in parenthesis are on dry basis.

tate comparisons). Table 3 shows that the total sugars content was reduced to 5-6 per cent after these potatoes were removed to room temperature. Likewise the total sugars contents of the Katahdins stored at 36° and 38° decreased to 7-15 and 4½—9 per cent, respectively to about 3-4 per cent. At 42°, the moderately low sugar contents remained about the same during the after-storage period. At 50° and 60°, the sugar contents actually increased. For example, Katahdins kept at 60° for 29 weeks contained 5.9 per cent total sugars, which increased to 7.8 per cent in the following 2 weeks. The potatoes which increased in sugar content sprouted considerably during this period; increase in sugar is believed to be associated with extensive sprouting, as pointed out in the discussion of table 5.

On removal from cold storage, the Green Mountain potatoes behaved about the same as the Katahdins. Table 3 shows that the Green Mountain variety, although it originally developed more total sugars than did the Katahdins, reached even slightly lower sugar values during reconditioning. Like the Katahdin variety, the Green Mountain potatoes lost only a small amount of their relatively low sugar contents on removal from storage at 42° to room temperature. There was an appreciable gain in sugar content during the 2 weeks following storage at higher temperatures. The Green Mountains kept at 60° for 29 weeks increased from 5.9 to 13.3 per cent in total sugars during the 2 weeks after storage.

It will be seen that the sum of corresponding values for starch and total sugars (both on the dry basis) in tables 1 and 2 gives total carbohydrates (minus cellulose and hemicellulose). These total values remain reasonably constant. Total carbohydrate values of potatoes after 2 weeks at room temperature following storage also agree well with those of potatoes taken directly from storage.

The Katahdins contained 74 per cent total carbohydrates on the dry basis at the time of entering storage. The percentages of total carbohydrate (averages for the entire storage period) were as follows: 34° F.—70 per cent at time of removal from storage bin and 69 per cent after 2 weeks of secondary storage; 36°—71 and 68 per cent; 38° F.—69 and 69 per cent; 42° F.—69 and 69 per cent; 50° F.—70 and 68 per cent; 60° F.—71 and 67 per cent. These data show little variation. There is, however, a drop from the original value, for which there is no ready explanation.

The Green Mountain potatoes contained 76 per cent total carbohydrates on the dry basis originally and, as the following average data show, there was little deviation at the various temperatures: At 34° F.—76 per cent at time of removal from storage and 74 per cent after 2 weeks at ordinary temperature following storage; at 36° F.—76 and 74 per cent; at 38° F.—77 and 75 per cent; at 42° F.—76 and 76 per cent; at 50° F.—77 and 76 per cent; at 60° F.—76 and 75 per cent.

The foregoing results show that under different conditions of storage an increase of sugars is accompanied by a corresponding decrease in starch, and *vice versa*. These data, however, do not take into consideration loss in weight during storage. The potatoes lost about 5 per cent of their original weight in 37 weeks' storage at 34° F., 5-½ to 6-½ per cent during the same period at 36° F., and about 7 per cent at 42° F. At 50° F., 6 to 6-½ per cent of the original weight had been lost at the end of 29 weeks; at 60°, the loss was 17 to 18 per cent during the same time.

It is of interest to know the loss in weight of starch and starch plus sugars occurring during storage. Table 4 shows loss of weight after storage at 34°, 36° and 42° F. for 13 and 37 weeks. Data for temperatures higher than 42° are omitted because they are of minor interest, owing to the fact that the temperature of Maine storage houses generally does not exceed this value.

TABLE 4.—*Loss in weight of starch and starch plus sugars during storage of Katahdin potatoes.*

Temperature Storage °F.	Loss of Starch During Storage for (Weeks)--		Loss of Starch Plus Sugars During Storage for (Weeks)--	
	13 Per cent a/	37 Per cent a/	13 Per cent a/	37 Per cent a/
34	24.3	29.1	15.8	19.4
36	29.4	31.6	12.9	17.9
42	11.3	15.6	10.4	15.6

a. Based on original content.

The conditions under which it was necessary to work in this study did not provide sufficient precision, especially in weighing, to permit determining differentially the amounts of sugar lost in respiration and consumed in synthesis to starch while the potatoes were held at room temperature after cold storage. Data taken at this Laboratory on other potatoes, however, show that sugars which disappear during reconditioning are converted at least partly into starch.

With the exception of the moisture content of potatoes which sprouted extensively, moisture content did not vary much from the original values. The moisture content of the potatoes held in storage for 29 weeks at 60° F. dropped only 1 to 1-½ per cent. Loss of weight, therefore, was generally distributed between water and solids in about the same proportion as in the original composition.

The Katahdin potatoes began to sprout in 7 weeks at 60° F. and soon afterward at 50° F.; incipient sprouting in this variety appeared after 13 weeks at 42° F. The Green Mountain potatoes stored at 50° and 60° F. started to sprout during the 13-week period. At 38° F., sprouting started in both varieties after 29 weeks but did not occur below this temperature even at 37 weeks. Sprouts were 1 to 2 feet long after 29 weeks' storage at 50° and 60° F., and the tubers were soft and shrunken. Katahdin potatoes in this condition were used to determine the composition of both the sprouts and the tubers. Although the sprouts constituted a minor fraction of the whole potato, table 5 shows that most of the reducing sugar was present in them. Total sugars were about equally divided between the two fractions. The sprouts fraction contained only a small amount of starch.

Although there are no generally accepted specifications for potato starch, the starch trade recognizes the following values as desirable: High degree of whiteness, low content of cold water-soluble material, low acidity, pH near 7, ash content about 0.35 per cent, low nitrogen content, and relatively high viscosity. Accordingly, these properties of starches produced in Maine factories in the fall of 1945 were compared with those of starches produced in the same factories in the spring of 1946. It was found that starch from the stored potatoes was essentially of the same

TABLE 5.—*Analysis of Katahdin tubers and sprouts after storage at 60° F. for 29 weeks.*

	Tubers		Sprouts	
	Based on Fraction	Based on Whole Potato	Based on Fraction	Based on Whole Potato
	Per cent	Per cent	Per cent	Per cent
Starch	15.4	13.1	3.1	0.5
Total sugars	0.37	0.31	2.58	0.39
Reducing sugars	0.1	0.1	2.55	0.38

Tuber fraction = 85 per cent by weight of whole sprouted potatoes. Moisture, 78.6 per cent.

(Sprouts fraction = 15 per cent by weight of whole sprouted potatoes. Moisture 90.7 per cent.)

quality as that from freshly harvested potatoes. Starches produced in 19 factories in the fall of 1945 and the spring of 1946, had the following average values: Whiteness (Measured with a G. E. automatic recording spectrophotometer; reflectance at 450 mu wave length compared to magnesium oxide at 100 was used), 82.5 and 82.2 respectively; cold water-soluble material, 0.25 and 0.23 per cent; acidity equivalent to 19.1 and 16.9 cubic centimeters of 0.1 normal sodium hydroxide per 100 grams starch; pH (measured with an electrometer; suspension of 1 gram starch in 5 grams water was used), 6.5 and 6.1; ash, 0.36 and 0.35 per cent; nitrogen, 0.01 and 0.02 per cent; viscosity of 2 per cent paste at 194° F., 572 and 615 centipoises.

DISCUSSION

From the point of view of the food consumer there is little loss in the food value (carbohydrate contents) of potatoes kept in cold storage. Growers who store their potatoes and later sell on a weight basis, however, will have to take into consideration the loss in weight. Shippers, dealers, and distributors who buy and sell potatoes must make allowance

for loss in weight, although their total percentage of carbohydrates remains practically unchanged. Potatoes kept in cold storage for 2 to 3 months contain only about 70 per cent of their original starch. If potatoes are to be processed for production of alcohol or other fermentation product in which conversion to sugar is the first step, or are to be hydrolyzed to crude glucose syrup, then stock taken directly from cold storage should be acceptable.

Sprouts are considered objectionable because they cause difficulties in washing the potatoes; starch manufacturers generally insist that they be removed prior to acceptance of the potatoes. Little starch is lost by their removal.

Summary and Conclusions

The effects of storage at 34° to 60° F. on the composition of potatoes was studied. The total carbohydrate content changed but little. Loss of carbohydrate material and of moisture occurred at about the same rate, so that the percentage of solids remained nearly at the original level. Potatoes removed from cold storage and kept for 2 weeks or more at ordinary temperatures increased in starch content. Potato sprouts contained little starch but a relatively large percentage of sugars. Commercial starch produced from stored potatoes in the spring of 1946 had essentially the same quality as that from freshly harvested potatoes in the fall of 1945.

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THE SARANAC POTATO: A NEW VARIETY PROMISING IN AUSTRALIA

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and

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ORIGIN

The Saranac potato, U.S.D.A. Seedling No. 336-144, was one of a number of seedlings and varieties sent to the Department of Agriculture, Sydney, Australia, in 1938. This is in keeping with the policy of the U.S.D.A. to send plant materials to foreign countries in exchange for varieties of foreign origin. Seedling 336-144 has been very promising in certain sections of Australia, and the Department of Agriculture at Sydney has requested that it be named so that it may be entered on their certified potato lists and distributed to growers.

Saranac was produced in 1932 from seed at Presque Isle, Maine. It was a selection from a cross of President x Katahdin. President has been called by several names in the United States. It was first described by Bonde as Foster's Rust Proof (1). It was later called No Blight, and still later identified as President. Clark and Lombard (3) have given four synonyms for President: Paul Krüger, President Krüger, No Blight, and Rust Proof. Although President is very late maturing and is moderately resistant to late blight, it is of no commercial value in the United States, for it usually produces only a small crop of U. S. No. 1 tubers. Katahdin is the most widely grown late variety of potato in the United States. It is grown extensively also in the Maritime Provinces of the Dominion of Canada.

DESCRIPTION

Plants.—Large size, erect; stems medium thick, slightly angled; nodes slightly swollen, green; internodes green; wings slightly waved; stipules medium size, green, scant pubescence; leaves medium length and width; midrib green, sparsely pubescent; primary leaflets three or four pairs, ovate, medium size, mean length of blade 56.4 mm, mean width 29.2 mm, index 51.8; leaflet petioles green; secondary leaflets few in number, between pairs of primary leaflets; tertiary leaflets none.

Flowers.—Inflorescence little branched; leafy bracts none; calyx

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lobes medium long, green, sparsely pubescent; corolla medium size, white; anthers orange yellow; pollen medium in quantity and quality; style straightt; stigma flattened globose, not lobed, green.

Tubers.—Round; mean length 83.1 mm., mean width 79.5 mm., mean thickness 61.8 mm; indexes, width to length 95.6; thickness to width 77.7; thickness to length 74.4; skin flaked, self-colored, ivory yellow; eyes shallow, same color as skin; eyebrows medium long and medium prominent; flesh white; maturity late.

CHARARTERISTICS

The cross between President and Katahdin was made as a part of a study of the inheritance of resistance to late blight. From this cross 467 selections were tested for resistance to this disease in the greenhouse at Arlington Farm, Virginia, in the spring of 1934 (4). About one-third of them showed as much resistance to late blight as the President. Saranac was one of these. In the field tests in Maine where the plants were sprayed with a suspension of blight spores the reaction of this variety to late blight varied somewhat in 9 years' tests but for any given year it always showed an intermediate type of resistance quite similar to that of the President parent.

Saranac was found to be resistant to ring rot, *Corynebacterium sepedonicum* (Spieck and Kott). Skap. and Burk., as shown by Bonde *et al.* (2). In tests where it was severely infected with the organisms causing this disease it contracted very little disease for four successive years. In contrast, susceptible varieties like Katahdin and Green Mountain developed a high percentage of infection and did not survive the test for more than one year.

It has been used as a parent in the United States because of its ring-rot resistance and some of the progeny of crosses, in which it was one of the parents, have shown a degree of resistance to brown rot or Southern bacterial wilt.

It is too late maturing for most of the potato-growing sections of the United States. It has shown the greatest promise in Franklin County, New York, and for several years it was considered for introduction in that state. However, it was found to be so susceptible to leaf roll in both New York State and Maine that it was decided not to increase and distribute it in the United States.

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THE EFFECT OF TIME OF HARVEST, VARIETY, AND STORAGE OF THE ASCORBIC ACID CONTENT OF POTATO TUBERS

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INTRODUCTION

A program of breeding potatoes for a higher asorbic acid (vitamin C) content is necessarily based on accurate evaluation of the material under study. Accurate evaluation of varieties as sources of ascorbic acid is possible only when the effects of other factors which might influence ascorbic acid content are known. Some of the more obvious of these factors are stage of maturity, environmental factors in the field, storage conditions, and their interactions. The data herein reported are from a preliminary study of the influence of such factors.

Numerous investigators have reported varietal differences in the ascorbic acid content of potato tubers, and no attempt is made to present a review of all the papers on the subject. Karikka, Dudgeon, and Hauck (1) reported significant varietal differences, with Katahdin having a high ascorbic acid content and Chippewa having a low. Murphy, Dove, and Akeley (3) reported a similar relation between these two varieties.

A steady decline of the ascorbic acid content of potatoes during storage has been reported by Thiessen (7), Wachholder (8), and others. Smith and Patterson (6) found that potatoes in cold storage were higher in ascorbic acid content than those stored at room temperature. On the other hand, Karikka, *et al.*, (1) observed that potatoes stored at 50°F. lost less ascorbic acid than those stored at 40°F. Lampitt, Baker, and Parkinson (2) reported that the asorbic acid in potato tubers declined steadily until January and then remained about constant. Also there was no difference in storage losses of ascorbic acid with potatoes grown at different locations.

Smith and Gillies (5) and Smith and Paterson (6) in England stated that the ascorbic acid content of potato tubers increased until August and then began to decline as the tops died. Lampitt, *et al.* (2) found no change in the ascorbic acid concentration of potato tubers after the tubers were well formed. Murphy, *et al.* (3) found that a group of late-maturing varieties had a higher ascorbic acid content than a group of early-maturing varieties. In the latter case, all varieties were harvested at the same time, *i.e.* some time after the

early varieties had matured. They concluded that the difference may have been due to the immature condition of the late-maturing varieties.

PROCEDURE

The potatoes used in this experiment were obtained from the commercial fields of Richard Amidon, a potato grower at Lafayette, New York. The Irish Cobbler and Warba varieties were grown in the same field. The Chippewa, Pontiac, and Sebago varieties were obtained from a different field, and the Katahdin variety was grown in a third field. All the fields were in the same general area on Ontario loam at an elevation of about 1700 feet. All varieties were planted from the 26th to 29th of May, 1946, and the fields were fertilized with about one ton of 5-10-5 per acre. The usual fungicidal spray program was followed and DDT was used to control insects.

Samples were taken for analysis on the 31st of August, the 16th of September, and the 2nd of October, 1946. On the first two dates a random sample of ten hills was harvested from each field. The weight of tops and tubers and number of tubers was recorded for each hill. The Chippewa field was sprayed with a vine-killer (Dow 66 Improved) on the 11th of September, and the tops were completely dead at the time of the second harvest. The Katahdins were sprayed on the 15th of September, but there was little damage to the tops at the time of the second harvest. The vines of Warba and Irish Cobbler were completely dead at the second harvest and it was impossible to determine accurately individual hills; therefore, no yield data were obtained. At the last date, all varieties with the exception of Sebago had been harvested the previous week by the grower, and two bushels of each variety were selected from the storage bins. A two-bushel sample of Sebago tubers was dug on the 2nd of October. At the laboratory, the tubers were washed and placed in storage at 40°F. until they were analyzed (not more than two days after digging). At each harvest date, twenty tubers of each variety were analyzed individually for ascorbic acid. The percentage dry weight of each tuber was obtained at the same time.

For the storage study, a number of ten-tuber samples of each variety were stored in open paper bags at 40°F. until analyzed for ascorbic acid. Upon removal from storage, two median longitudinal slices, each weighing about 20 grams, were cut from each tuber. One was dried in a forced-draft oven at 70°C. for 48 hours to obtain the dry weight. The other slice was used for the determination of ascorbic acid by the method described by Nelson and Somers (4). Previous experiments indicated that the ascorbic acid content of a medium

longitudinal slice was the same as the ascorbic acid content of the whole tuber.

The standard error of each mean was calculated and the significance of differences was determined by Student's "t". Odds greater than 19:1 were considered significant.

Result and Discussion

The data obtained at each harvest are presented in table 1 and figure 1. The data concerning the vegetative growth of the plants in the field (the weight of tops and tubers) are presented to serve as an indication of the maturity of the plants at each date of harvest. The tubers were considered mature when the tops were dead and the periderm of the tubers did not "skin" with the usual handling. The Warba and Irish Cobbler tubers were mature at the first harvest. Pontiac, Katahdin, and Chippewa were mature at the second harvest or shortly afterward as a result of spraying with a vine-killer. The Sebago plants were still green and in good condition at the third harvest. During the period of study only the Sebago variety showed an appreciable increase in yield of tubers.

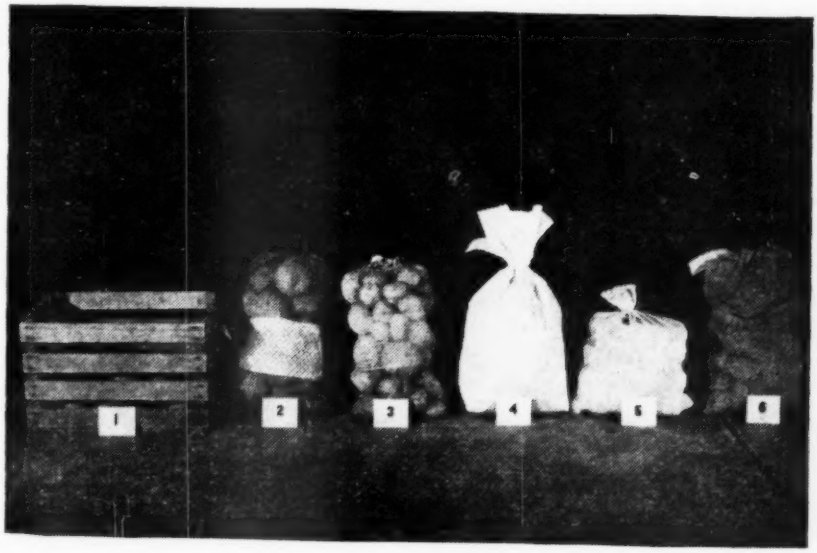

Fig. 1. Containers used in Potato Storage Experiment. Left to right: 1. Crate. 2. Saxolin. 3. Chasenet. 4. Paper. 5. Cotton. 6. Burlap.

TABLE I.—*The effect of date of harvest on the ascorbic acid content of several varieties of potatoes stored at 40°F.*
(*Mean ascorbic acid content as mg. per 100 gms. fresh weight at the time of analysis ± the standard error.*)

Variety	Date of Harvest	Days in Storage						
		0	12 - 16	32	50	64 - 66	84	98
Warba	Aug. 31	32.3 ± 0.96	24.2 ± 1.71	19.8 ± 0.76	- - - - -	9.5 ± 0.44	- - - - -	- - - - -
	Sept. 16	25.1 ± 1.35	25.0 ± 0.82	- - - - -	13.9 ± 0.85	- - - - -	8.4 ± 0.59	- - - - -
	Oct. 2	22.1 ± 1.14	26.0 ± 1.14	14.5 ± 0.81	- - - - -	11.0 ± 0.29	- - - - -	8.8 ± 0.19
Irish Cobbler	Aug. 31	28.4 ± 0.99	24.3 ± 0.86	17.3 ± 0.69	- - - - -	11.5 ± 0.39	- - - - -	- - - - -
	Sept. 16	24.4 ± 1.13	18.8 ± 0.78	- - - - -	12.4 ± 0.33	- - - - -	7.5 ± 0.32	- - - - -
	Oct. 2	22.0 ± 0.66	24.9 ± 0.83	14.1 ± 0.32	- - - - -	11.4 ± 0.38	- - - - -	8.4 ± 0.21
Chippewa	Aug. 31	22.3 ± 0.80	19.0 ± 0.75	14.8 ± 0.42	- - - - -	11.1 ± 0.35	- - - - -	- - - - -
	Sept. 16	23.3 ± 0.89	22.6 ± 1.30	- - - - -	13.9 ± 0.48	- - - - -	9.1 ± 0.35	- - - - -
	Oct. 2	18.6 ± 0.87	17.8 ± 0.79*	11.1 ± 0.55	- - - - -	9.3 ± 0.59	- - - - -	7.2 ± 0.24
Katahdin	Aug. 31	31.9 ± 0.92	25.7 ± 1.32	21.1 ± 1.57	- - - - -	12.2 ± 0.35	- - - - -	- - - - -
	Sept. 16	35.8 ± 1.54	33.4 ± 1.47	- - - - -	18.0 ± 0.85	- - - - -	11.3 ± 0.62	- - - - -
	Oct. 2	32.3 ± 1.21	27.0 ± 1.29	22.4 ± 0.81*	- - - - -	16.8 ± 0.59	- - - - -	12.6 ± 0.41
Pontiac	Aug. 31	29.0 ± 1.22	21.9 ± 1.32	17.8 ± 0.85	- - - - -	9.3 ± 0.23	- - - - -	- - - - -
	Sept. 16	29.0 ± 1.20	24.6 ± 1.42	- - - - -	17.9 ± 1.65*	- - - - -	10.3 ± 0.52	- - - - -
	Oct. 2	25.5 ± 0.92	23.5 ± 1.66	17.4 ± 0.69	- - - - -	13.0 ± 0.68	- - - - -	8.6 ± 0.27
Sebago	Aug. 31	26.0 ± 1.01	18.2 ± 0.78	16.9 ± 0.58	- - - - -	8.8 ± 0.28	- - - - -	- - - - -
	Sept. 16	25.1 ± 0.85	23.7 ± 1.14	- - - - -	14.3 ± 0.65*	- - - - -	8.2 ± 0.22*	- - - - -
	Oct. 2	25.6 ± 1.39	25.7 ± 0.67	17.5 ± 1.13	- - - - -	11.4 ± 0.51	- - - - -	7.9 ± 0.31

*Note: Mean calculated from 9 tubers.

There was no significant change in the ascorbic acid content of the tubers of any variety from the time of the first sampling until maturity of the vines. As soon as the tops died, the ascorbic acid content of the tubers began to decrease whether the tubers were dug and placed in storage or left in the ground. The two early varieties (Warba and Irish Cobbler) were mature at the first harvest as indicated by the condition of the tops and the nature of the periderm of the tubers. These varieties showed a continual decrease in ascorbic acid at each succeeding harvest. The Pontiac, Katahdin, and Chippewa varieties were mature or had been killed at the second harvest, and a significant decrease in ascorbic acid content of the tubers was observed at the third harvest. The Sebago tubers had the same ascorbic acid content at each of the three harvests and the tops were still living at the third harvest.

These data indicate that the ascorbic acid content of potato tubers was not affected by the stage of maturity of the tubers as long as the tops were living. This does not necessarily mean that there is no effect of maturity on the ascorbic acid content of potato tubers. The tops of the plants had attained their maximum size at the time of the first harvest, and only one variety (Sebago) showed an appreciable increase in yield of tubers. Therefore, the range of maturity studied was not very great. In addition, the effect of the different environmental conditions prevailing at each harvest date cannot be validly separated from the effect of maturity in this type of experiment. The loss of ascorbic acid in the tubers upon death of the tops may be considered conclusive since it was observed with more than one variety on each of two harvest periods. This observation has also been reported by Smith and Gillies (5).

The problem of evaluating potato varieties as sources of ascorbic acid is illustrated by the data presented in table 1. Since the ascorbic acid content of the tubers decreased after the tops died, the ascorbic acid content of Warba and Irish Cobbler potatoes at the first harvest only is valid. If all varieties are compared at the first harvest, the stage of maturity must be ignored. A comparison made at the time of maturity necessarily ignores the possible effect of climatic differences at the various harvest dates. A comparison of the ascorbic acid content of these varieties at the time each variety was mature shows that the Warba and Katahdin tubers were high; Sebago, Pontiac, and Irish Cobbler were intermediate; and the Chippewa tubers were low in ascorbic acid. These results should be accepted with reservation since the varieties were grown in unreplicated fields and the varieties matured at different times.

Samples of these potatoes were found to decrease in ascorbic acid content throughout the period of storage (3 months) at 40° F. as is shown in figure 2. There were differences in the rate of loss of ascorbic acid, in some cases apparently associated with maturity or date of harvest. However, the nature of the data does not warrant a conclusion as to the effect of maturity of the tubers on the loss of ascorbic acid during storage. It is interesting to note that the Warba and Irish Cobbler tubers significantly increased in ascorbic acid when placed at 40°F. after the third harvest, at which time the tops had been dead for one variety and occurred with the Warba and Irish Cobbler varieties only after the third harvest. This increase was not noted with any other variety and occurred with the Warba and Irish Cobbler variety only after the third harvest. The ascorbic acid content of tubers of these two varieties was significantly higher after two weeks' storage at 40° F., but after this time, the ascorbic acid content rapidly decreased. After approximately six weeks' storage, the ascorbic acid content of these tubers was about the same as that of tubers harvested earlier and stored for the same length of time. These changes in the ascorbic acid content of the potatoes in storage could not be accounted for by changes in the per cent dry weight of the tubers. The same relationships held when the ascorbic acid was calculated on a dry weight basis.

In an attempt to evaluate potato varieties as sources of ascorbic acid, it is imperative to consider both the time of maturity and the length of time in storage. In effect, the storage period begins as soon as the tops die since the tubers are then dependent upon stored carbohydrates. When a number of varieties are harvested at the same time, the varieties maturing before the time of harvest have actually been in storage for a period of time. Therefore, this type of comparison is biased. Harvesting all varieties when the earliest-maturing variety is mature also introduces a bias because the later-maturing varieties would be immature. A comparison of the ascorbic acid content of potato varieties at the time of maturity is another alternative; such a comparison would also be biased since the various varieties would mature with different climatic conditions prevailing. It is obvious that more comprehensive experiments are needed before an extensive study of the ascorbic acid content of potato varieties can be undertaken.

SUMMARY

Six varieties of potatoes were harvested on each of three different dates during the last month of the growing season. The ascorbic acid content of the tubers did not change as the tubers matured. Upon death of the tops, the ascorbic acid content of the tubers began to

decline. The tubers continued to lose ascorbic acid in storage throughout the two-month storage period studied. A satisfactory method of comparing the ascorbic acid content of potato varieties has not been devised at the present time.

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REPORT OF THE ANNUAL MEETING OF THE POTATO ASSOCIATION OF AMERICA

ANNUAL MEETING

The annual meeting of the Potato Association of America, held at Pittsburgh, December 6, 7 and 8, 1948 was well attended despite the fact that announcements of the meeting were late in reaching the majority of the membership. A total of 94 persons registered and numerous other persons who did not register attended some of the sessions. The quality of most of the papers presented at the meeting was excellent and they will be published in subsequent issues of the Journal for the benefit of all members.

MEETING OF THE 1948 EXECUTIVE COMMITTEE

At the business meeting of the Executive Committee held Sunday evening, December 5, Vice-President Burke in the absence of President Newdick, appointed the following committees:

Auditing Committee:
H. W. Darling, *Chairman*
I. N. Hopkins
W. R. Mills

Nominating Committee:
Rinear Bonde
Frank Garrett
R. C. Hastings

President Newdick previously appointed the following to the *Potato Introduction Committee*:

G. Rieman, *Chairman*
F. J. Stevenson
Donald Reddick
Julian C. Miller
William Riedl

The Treasurer was authorized to charge a mark-up of 25 per cent above the cost of reprints for articles printed in the Journal, but no charge was to be made for mailing or handling. There being no further business the meeting was adjourned.—H. A. REILEY, *Secretary*.

Since this authorization was granted the publisher has increased

the cost of printing 6 per cent, for this reason the Treasurer has increased the price of reprints only 20 per cent above our cost.

Meeting of the Potato Association of America

At the Annual Business Meeting held Tuesday morning, December 7 Vice-President Burke again presided. The Secretary read a letter from President Newdick expressing his regret for not being able to attend. Following the reading of the minutes of the last annual meeting the Treasurer's report was given and accepted. A copy of this report appears on page 72.

The Auditing Committee examined the books and certified that they were correct.

The Editor's report was made by Mr. Campbell in the absence of Dr. Martin. This report included a breakdown of the membership of the Association by states. It was pointed out that there was a total of 2667 members of which 1700 were group members, received at special reduced rates.

The Nominating Committee presented the following panel to serve on the Executive Committee for the year 1949. President, O. D. Burke, Extension Plant Pathologist, Pennsylvania State College; Vice-President, H. A. Reiley, of the Michigan Potato Growers' Exchange, Cadillac. Three directors were also elected: I. W. Hopkins, a prominent farmer of Pittsford, New York — 1 year; J. W. Scannell, Assistant Chief, Division of Plant Protection, Ottawa, Canada—2 years; and A. J. Tolaas, in Charge of Seed Certification, Department of Agriculture, St. Paul, Minnesota — 3 years.

Since there were no nominations from the floor the Secretary was requested to cast a ballot for the entire panel and they were unanimously elected.

The following officers were appointed by the newly elected President at the meeting of the Executive Committee held on the evening of December 7. Secretary—2 years; Ora Smith, Department of Vegetable Crops, Cornell University, Ithaca, New York, Treasurer—1 year; John C. Campbell, Department of Plant Pathology, Rutgers University, New Brunswick, New Jersey and Dr. William H. Martin, Dean of the College of Agriculture, Rutgers University was reappointed as Editor of the "American Potato Journal." E. L. Newdick, former president, will continue to serve on the executive committee as provided by the By-Laws.

Dr. G. H. Rieman presented the following recommendations regarding the establishment of a National Potato Introduction Station at

Sturgeon Bay, Wisconsin. The primary purpose of this Station is to collect and maintain species of potatoes that may have desirable breeding characteristics for use by geneticists in the various states and the U.S.D.A.

The recommendations were adopted as follows:

We recommend that the North Central Potato Introduction Station at Sturgeon Bay, Wisconsin, as now established, be organized as the National Potato Introduction Station, to serve the four regions of the country and the United States Department of Agriculture as designated in the Research and Marketing Act of 1946.

That further provisions be made to study the cytogenetic and systematic relationships of the new introductions to facilitate Potato Breeding programs throughout the Nation.

It is recommended that the Potato Introduction Committee representing the four regions and the United States Department of Agriculture, be appointed by The Potato Association of America and be authorized to formulate a National Potato Introduction Project.

It is recommended that the Secretary of the Potato Association of America submit the outline of this project to the following four Regional Administrative Advisors and the Chief of the Bureau of Plant Industry, Soils and Agricultural Engineering, and that the project outline be published in the American Potato Journal.

DR. S. V. SWENSON
State College of Washington
Pullman, Washington

DR. W. V. LAMBERT
Nebraska Agricultural Experiment Station, Lincoln, Nebraska

DR. J. L. LEWIS
College Station
Texas

DR. A. J. HEINICKE
Agricultural Experiment Station, Geneva, New York

DR. ROBERT SALTER
Plant Industry Station, Beltsville, Maryland

Prepared by the POTATO INTRODUCTION COMMITTEE FOR 1948 OF THE POTATO ASSOCIATION OF AMERICA

REINER BONDE
L. C. PETERSON
F. J. STEVENSON
G. H. RIEMAN, *Chairman*
L. W. NIELSON

No report was made by the Life Membership Committee. However, it was recommended that the names of persons to be so honored be obtained from Mr. Koehnke and that they be duly notified of this honor, and that proper citations be printed in the Journal.

Report of the Resolutions Committee, Chairman H. C. Moore: Be it resolved, that we the members of the Potato Association of America

express our appreciation for the services and untiring efforts of John Campbell and O. D. Burke in arranging the program for this excellent meeting.

Be it further resolved, that we express to Dr. William H. Martin our appreciation of his invaluable contribution to the continued success of this organization in the regular issuing and successful financing of the American Potato Journal.

Further, that we express our appreciation to those who have contributed articles and sectional notes for the American Potato Journal.

Be it resolved, that we extend our appreciation to the Hotel Fort Pitt for its co-operation in furnishing meeting rooms and other accommodations.

Be it further resolved, that we extend our thanks to the Pittsburgh Convention Bureau for the secretarial services of Mrs. Norris who has had charge of membership registration.

H. J. EVANS
H. C. MOORE, *Chairman*

Following the acceptance of these resolutions the meeting was adjourned. Respectfully submitted,

H. A. REILEY, *Secretary*.

MEETING OF THE 1949 EXECUTIVE COMMITTEE

At the meeting of the newly elected Executive Committee held Tuesday evening, December 7, Messrs. Burke, Reiley, Campbell, Smith, Hopkins and Scannell were present. Martin, Newdick and Tolaas were absent. President Burke presided and the following items of business were transacted.

(1) *Annual Meeting in* 1949

The Executive Committee voted to hold the next annual meeting in connection with the meeting of the International Crop Improvement Association on December 7, 8, 9, 1949, in Kansas City, Missouri, at the Hotel President.

(2) *Call for Papers*

It was agreed that the Secretary should send the notice for a call for papers to Dr. Martin in time to be included in the August or September issue of the Journal.

Deadline for submitting titles to the Secretary was set for October 20. Deadline for receipt of abstracts by the Secretary was set for November 15.

The Secretary is to submit the program of the meeting to Dr. Martin as soon as it is prepared for printing.

(3) *Expenses*

It was decided that:

(a) The Secretary should receive compensation to pay for work necessary to take care of secretarial duties and purchase of supplies.

(b) The Editor should receive a compensation of $400.00 annually.

(c) The Treasurer should receive a compensation of $600.00 annually.

(d) The Treasurer should be authorized to present Christmas presents to those who have done secretarial work during the year without compensation.

(4) *Committees*:

The following committees were appointed by President Burke:

Potato Introduction Committee: Donald Reddick, F. J. Stevenson, C. O. Erlanson, W. A. Riedl, J. C. Miller—and G. H. Rieman, *Chairman*.

It is suggested that this committee handle potato introduction affairs under the Research and Marketing Act.

Certification Committee: R. C. Hastings, K. W. Lauer, C. H. Godwin, W. H. Dunlap—and H. M. Darling, *Chairman*.

Membership Committee:

Marx Koehnke, Alliance, Nebr. (Central States)
Wm. Keenan, Ottawa, Canada, (Canada)
Frank Garrett, Fairhope, Ala. (Southern States)
Wm. Camp, Bakersfield, Cal. (Pacific Coast States)
H. J. Evans, Georgetown, N. Y. (Northeastern States)
E. C. Moll, Columbus, Ohio (Ohio, Indiana, Michigan)
Donald C. Umphrey, Presque Isle, Maine (New England States)
C. G. Woodbury, Idaho (Northwestern States)

Committee on Visual Education: R. J. Haskell, Washington, D. C.; Wm. Keenan, Ottawa, Canada; Gordon Brandeis, Philadelphia, Pa.; Duties: to locate movies, slides, photographs, *etc.* which would be suitable for the use of groups interested in potato production and marketing and to bring them to the attention of the Association.

Editorial Committee: The executive committee went on record authorizing the President to appoint an Editorial Board if the Editor feels that such assistance is desired.

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★

SUMMERS

FERTILIZER CO., INC.

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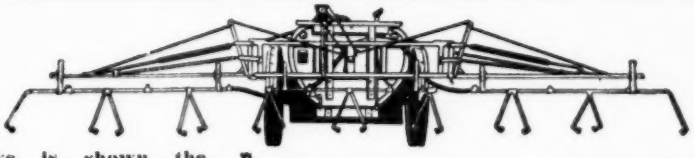
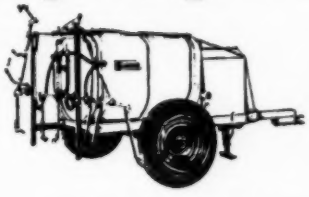
Bangor, Me. Sandy Point, Me. Mars Hill, Me. Grand Forks, N.D.
Searsport, Me. Houlton, Me. Caribou, Me. St. Stephen, N. B.



Above is shown the great new Hardie Level-rite Spray Boom for large scale operations. At right, the Hardie Foldrite, a remarkable new boom for average acreage.



Hardie offers you advanced row sprayers in a wide variety of models for spraying 2 to 12 rows. Hardie row crop spray booms embody some amazing, exclusive convenience features. Any Hardie row sprayer can be fitted with a high or low pressure weed boom. Today Hardie offers the row crop grower more investment and utility value than ever before.

Write for this Hardie 1949 catalog.

Hardie
Dependable Sprayers

Local Arrangement Committee: To be appointed later.

(5) *Other Business*

The Executive Committee agreed that the Association should sponsor the 1949 issue of the Potato Yearbook on terms similar to those in force for the 1948 issue.

There being no further business the meeting was adjourned.

Respectfully submitted,
ORA SMITH, *Secretary*.

SECTIONAL NOTES

ALABAMA

There seems to be a strong feeling among the Alabama potato growers to a plant a much smaller crop than allowed by the Government to qualify for support. The high cost of seed $4.35 to $4.50 per bag, the high cost of labor and fertilizer, and the effect of the reduction of parity this January seem to be the main reasons. Our farmers seem to realize that by planting less potatoes and using the best land, seed, and cultural practices that the net profit will be about the same as a large crop not so well handled. We probably will have a 30 per cent reduction in acres planted this year, there will most likely not be a 30 per cent reduction in production. There is always a probability that frost or blight could enter the picture to a very important extent.

Seed is arriving in an increasing amount and so far it seems that our dealers have purchased the best seed available. Some of the cars are showing frost in transit but this is a minor matter. Sixty five per cent of our crop will be Triumphs and the balance Sebago. Nebraska and North Dakota will furnish the bulk of Triumph seed with some from Minnesota. Wisconsin will furnish the bulk of the Sebago seed with P.E.I. selling quite a few cars. Maine will probably have a few cars in here also.

With normal weather conditions our growers will start planting in late January and will complete the bulk of the planting in approximately two weeks.

Our present plans call for some 225 samples of seed sources to be planted at the Gulf Coast Substation for the States of Wisconsin, Minnesota, North Dakota, Nebraska, and Wyoming. There will be about 40,000 tubers in the index part of our program.—FRANK E. GARRETT.

DISCS

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Discs for Friends Broom Nozzles 5c each

For Myers Fembro and Demming Brooms

Discs 5c Whirls 12c Strainers 10c each

For Old Iron Age Victory Nozzles

Discs 5c Whirls 25c Strainers 15c each

For Hardie Small Nozzles

Discs 5c each Whirls 25c each Strainers 15c each

WASHERS FOR THE ABOVE SIZE NOZZLES

Rubber 18c Doz.—Leather 15c Doz.

For Field Force, Tiger Nozzles, etc.: Discs 5c each

Two Hole Steel or Brass Whirls 30c Strainers 15c each

Rubber Washers 30c doz. Leather 18c doz.

For Farquhar Iron Age, Blitz, Bean Majestic, Myers Jumbo, Hardie Large Potato Nozzles, etc.

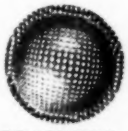
Discs 5c each Two Hole Brass or Steel Whirls 30c each

Three Hole Brass Whirls 35c Steel Whirls 40c

Strainers 15c each Rubber Washers 30c Leather 20c doz.

Myers Jumbo Whirls 25c Hardie Large Whirls 25c each

Hardie Large Strainers 15c each



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NEBRASKA

The report on potatoes from Nebraska may or may not be published, since mail from this territory frequently has wound up in a snow drift in the last six or eight weeks. Mother Nature has been on a rampage since some time in November, so long ago, we fail to remember just when it started.

We thought weather conditions were rough in the early part of the winter, but on January 2nd, a blizzard hit this territory that is the equal to any the old timers can remember. From here on we shall talk about the blizzard of January '49. As a result of a three-day snow fall with high winds and sub-zero temperatures, we had no trains moving in the state for a period of eight days. That meant that all transportation was at a standstill during that period. Following this several of the branch line railroads on which major stocks of potatoes are located have had service only one or two days during the past thirty days. That short period, of course, meant no movement of potatoes, only critical supplies of food and fuel.

In view of the fact that the Certified seed shipments to the Gulf Coast States are usually at their peak during this period, it can be readily seen what a mess the potato business faces as of this moment.

The movement of seed potatoes is hoplessly behind schedule, and prospects of improvement are very slim indeed. Many shippers who have been very patient to date have started cancelling their orders because it will soon be too late for planting in the southland. To complicate matters further, there is a critical car shortage, because the railroads are unable to move in equipment.

The situation, of course, has affected many agricultural products, other than potatoes. In this general area, livestock is very critically affected. All local and state resources for opening roads have been mobilized, and the Federal Government is moving in the Fifth Army from Colorado and Indiana. They are moving in bulldozers, weasels, and all kinds of winter equipment for opening roads to save what livestock has survived the past thirty days of strenuous weather. High losses have already been experienced, and more are expected. Many farmers, not over 10 to 20 miles from town, have been supplied with food and fuel by airplane, and hay is being dropped to isolated cattle herds from C-47 transports.

This isn't much about the potato business, but it gives an inkling of what one territory in the country has been suffering for the past thirty to sixty days. Prospects for next year are very confused at this moment. There is a reduction proposed, but if we cannot ship our seed

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potatoes south we may have an increase in acreage instead. Some of our seed potatoes are too small to be sold as table stock, and consequently will have to be salvaged in this manner. What started out to be a fairly good quality and about average yield may turn out to be a very disastrous crop before the situation clears.—MARX KOEHNKE

NEW YORK

Much interest is being manifest among potato growers regarding the 26 per cent cut reputed to be the figure for New York in the recent government allotment program announcement. There is not too much resentment about the cut but rather the course of action seems to be one of planning for more harvest production by utilization of better soils, more and better seed and approved cultural practices.

The outlook for Marketing Agreements appears better as time goes on, not only as a means of improving quality that goes to market but as a means of enforcing planting regulations. Marketing Agreements will receive considerable attention at the Annual Meeting of the Empire State Potato Club being held in Utica at Hotel Hamilton, January 5-6-7.

Favorable comment on the whole, is occasioned by the better enforcement by the Department of Agriculture and Markets of the Branding Law. Quite a few violations have occurred, potatoes requiring many potatoes to be regarded. This is having a good effect on everyone who markets.

The movement of certified seed potatoes is slow because of the uncertainty of individual farm allotments, the influx of Canadian Certified seed which came in with tags under the seed quota to table stock distributors who were supposed to remove tags before reselling, and the unsettled conditions as a whole. In the meantime, a lot of good certified seed is going to market and there will not be a surplus by spring.—H. J. EVANS

OREGON

A marketing agreement is in affect here this year for the first time. This covers the counties of Deschutes, Crook and Klamath in Oregon, and Modoc and Siskiyou, in California and involves around 25,000 acres of potatoes, mostly Russets. The cull regulation of course, is in effect, as well as a two inch minimum. U. S. Number 2's, 1B's and fringe 1's from 1⅞ to 2 inches in diameter are being diverted under the support program for livestock feeding. It has also been necessary at times to divert higher grades to livestock feeding. Growers seem to be satisfied with the present marketing agreement set up.

Acreage reduction for 1949 perhaps will not affect the Klamath area very much as growers reduced voluntarily following government demands for increased production of potatoes during the war. From an all time high of over 28,000 acres during the peak war years, the acreage has been reduced to less than 16,000 acres in 1948. It is believed that the 1949 acreage will be about the same. The practice of reducing acreage and planting only those lands in shape for good potato production is improving per acre yield and quality of the Klamath potato.— C. A. HENDERSON

SOUTH CAROLINA

Local growers are naturally disappointed in the new parity on potatoes. This, in addition to a poor general outlook and insufficient working capital has lowered the anticipated acreage to a point where practically all growers are being allowed to plant all the potatoes they desire. Not a single complaint on acreage reduction has been registered.

The huge losses because of seed rotting from excessive rains last year left many growers in poor financial condition for paying the high production costs of the 1949 crop.

It is a bit early to predict variety percentages but the old standard Cobbler is being replaced by Katahdin and Sebago. Incidentally seed for the entire crop of these white varieties is coming from Prince Edward Island because of about $1.00 per bag price differential under Maine. Seed for the small percentage of the acreage planted in Red Bliss and Pontiac is coming from the mid-west as usual. Our seed inspectors report that the seed is apparently in excellent condition. The weather conditions for land preparation are ideal. We expect to be planting by the end of this week.—W. C. BARNES

WASHINGTON

The Washington seed potato test plots are located at Camp Pendleton, California, again this year. The plots were planted on the 1st and 2nd of November. They should be ready for a disease reading the third or fourth week in January, providing the weather is not too cold. One hundred and fifty samples submitted by seventy-two growers were used for the test plots.

Seventy samples are being tested for disease in a greenhouse at Mt. Vernon, Washington. The majority of these samples are duplicates of those being tested in California in order to make comparisons of the results.

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THE NATION'S LEADING FERTILIZER SUPERPHOSPHATE

There were 2,063.5 acres of potatoes entered for certification this year with 1,727.5 acres certified. This consisted of 1,221 acres of White Rose; 389.2 of Netted Gems; 53 of Cal Rose; and the balance were Bliss Triumph, Beauty of Hebron, Burbank, Early Hose, Gold Coin, Irish Cobblers, Katahdin and Sebago. The estimate of the production for all varieties is 14,868.5 tons, or 561,722.4 bushels.

Harold S. Schaad, who has been in charge of potato certification in this state for several years left the Seed Division December 15th. He is now Potato Specialist for Balcom and Moe at Grandview, Washington.—RICHARD E. CRIPPEN

CANADA

The final estimated production of certified seed in Canada is placed at 12,847,000 bushels. This is 1,100,000 bushels more than produced in 1947 and is the highest production on record. Of this total, 5,396,700 bushels are Katahdin. This is an increase of approximately 2,000,000 bushels more than produced in 1947. There were 2,673,500 bushels of Green Mountain and 2,117,000 of Irish Cobbler produced in 1948. This shows a reduction of approximately 1,000,000 bushels in the Green Mountain variety and about 200,000 in the Irish Cobbler variety. Most of the Katahdin are produced in New Brunswick whereas Prince Edward Island produces the bulk of the Green Mountains and Irish Cobblers.

Pontiac variety appears for the first time in our list as it was not licensed for sale in Canada until 1948. There were approximately 152,000 bushels of this variety produced in 1948. Most of this stock was in New Brunswick. The yields of all varieties were quite good and most of the harvesting was done under ideal conditions.

Under a recent trade agreement between Canada and the United States, seed potatoes moved to the United States under a permit only. These permits are issued in accordance with the dates of planting, that is, that potatoes to the South are permitted to go forward now whereas potatoes to the Northern States, such as New Jersey, are not permitted entry until January 15; Maine, February 1; New York, Long Island, February 1; and New York (Up State) March 1.—J. W. SCANNELL

STATEMENT FOR THE YEAR ENDING NOVEMBER 30, 1948

RECEIPTS:

Balance on hand, December 15, 1947	$2,718.61	
Annual Dues	3,298.47	
Sale of Advertising	3,170.93	
Sale of Reprints	322.00	
Miscellaneous	39.98	
TOTAL RECEIPTS		$9,549.99

DISBURSEMENTS:

Printing of Journal (11 issues)	$4,044.01	
Printing of Reprints	323.25	
Mailing and Supplies	665.40	
Editorial Work	400.00	
Secretarial Work	650.00	
Indexing American Journal	300.00	
Miscellaneous	336.35	
TOTAL DISBURSEMENTS		$6,719.01
BALANCE ON HAND November 30, 1948		$2,830.98

ACCOUNTS RECEIVABLE:

Advertising for Sept., October and November	Approx.	$385.00
Reprints		129.50

ACCOUNTS PAYABLE:

Printing of October and November issues	Approx.	$800.00

JOHN C. CAMPBELL, *Treasurer.*

BOOK NOTES

The Potato. W. G. Burton, Cambridge, England: Chapman and Hall, London, 1948. Pp. 319. (Illustrated) 25/ Net.

After an excellent chapter on the history of the potato, the author discusses the various factors influencing dry matter, including the effect of climate, length of growing season, soil type, manuring, diseases and pests, and the variety and kind of seed. Additional chapters discuss the distribution and composition of the dry matter in the potato tuber, the nutritive value, cooking quality and storage. Appendices list the uses of potatoes other than for human food consumption and specific gravity as a guide to the content of dry matter and of starch in potato tubers. Each chapter is followed by a number of references.

While "The Potato" has largely to do with the crop as grown in England, all interested in the production of this important crop could read it with very great interest and profit. The author is to be congratulated on his attempt to summarize our knowledge of the potato as a source of food, more particularly from the viewpoint of a plant physiologist. Producer and research worker alike will benefit from Mr. Burton's contribution.

CORRECTION

In the January, 1949 issue, in the article entitled "Further Studies on the Influence of Sprout-inhibiting and Sprout-inducing Treatments on the Growth and Yields of Potatoes" the figures in column 2, table 3, on page 10, should head as follows:

10.9
0.4
0.2
0.6
0.3

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